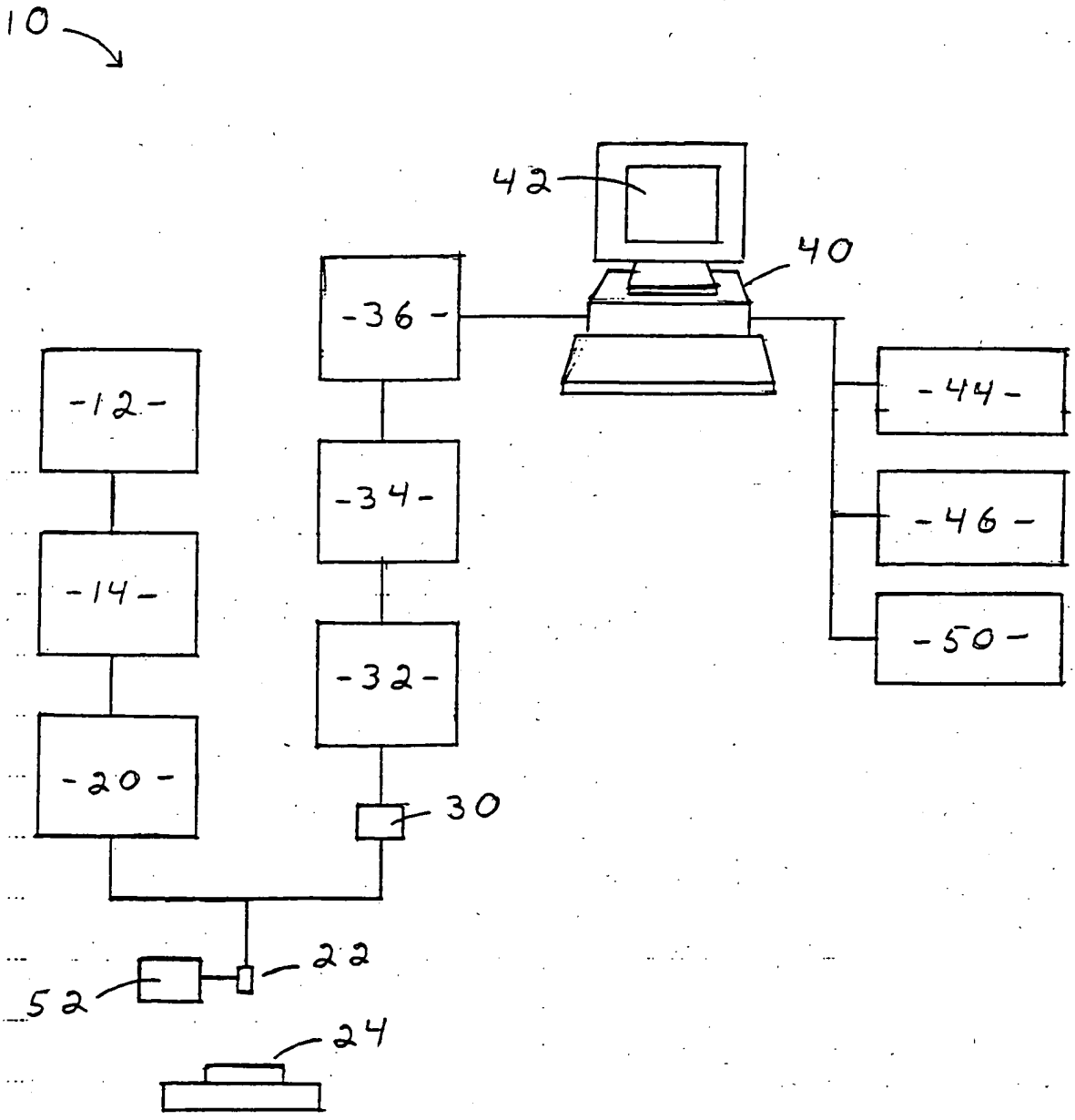


Fig. 1

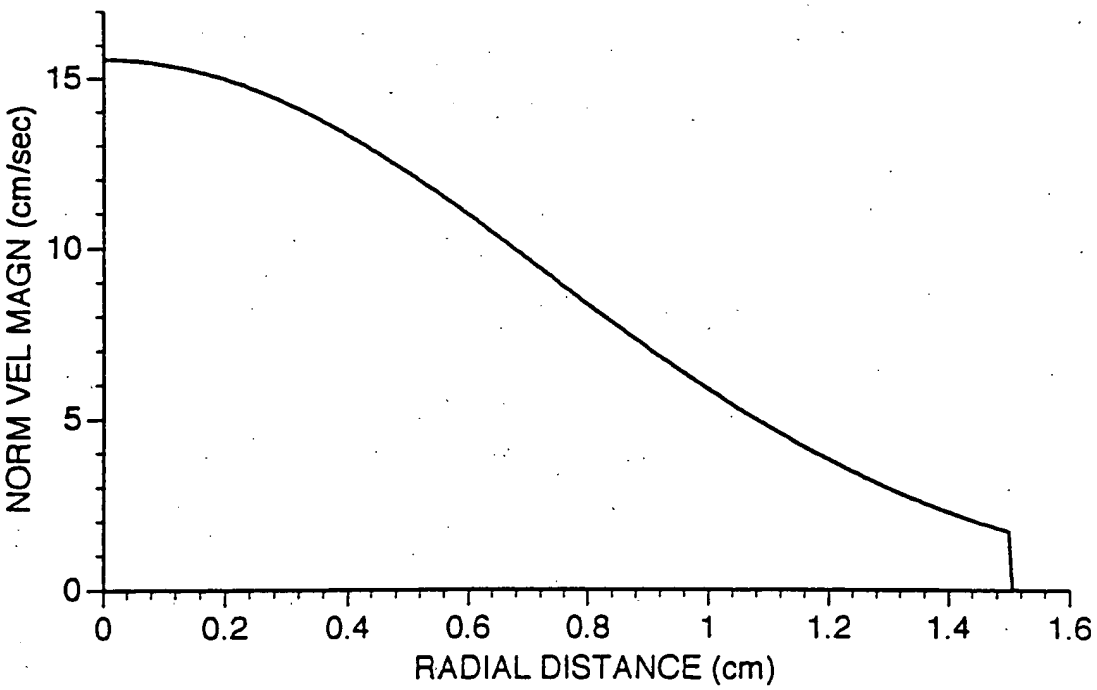

NORM VEL MAGN (cm/sec)
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
RADIAL DISTANCE (cm)

Fig. 2a

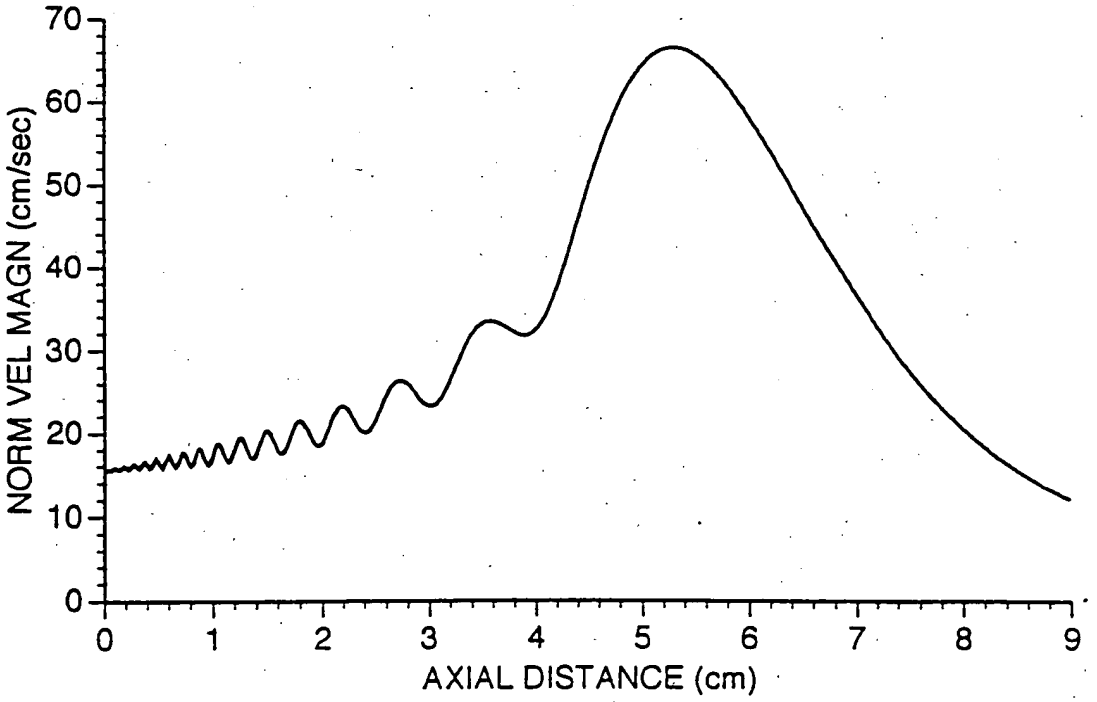

NORM VEL MAGN (cm/sec)
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
AXIAL DISTANCE (cm)

Fig. 2b

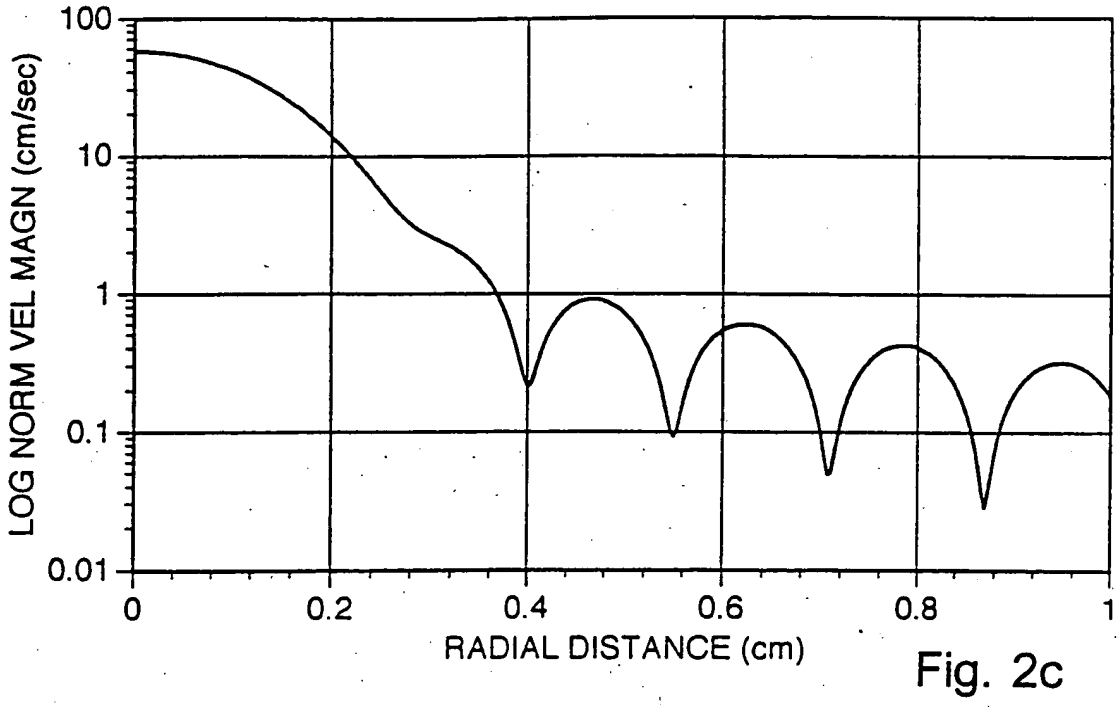


Fig. 2c

Linear propagation results for a focused 2 MHz Gaussian transducer operating in a liver medium. (a) The source plane amplitude profile. (b) The on-axis amplitude. (c) The radial focal plane (z = 6 cm) beam profile.

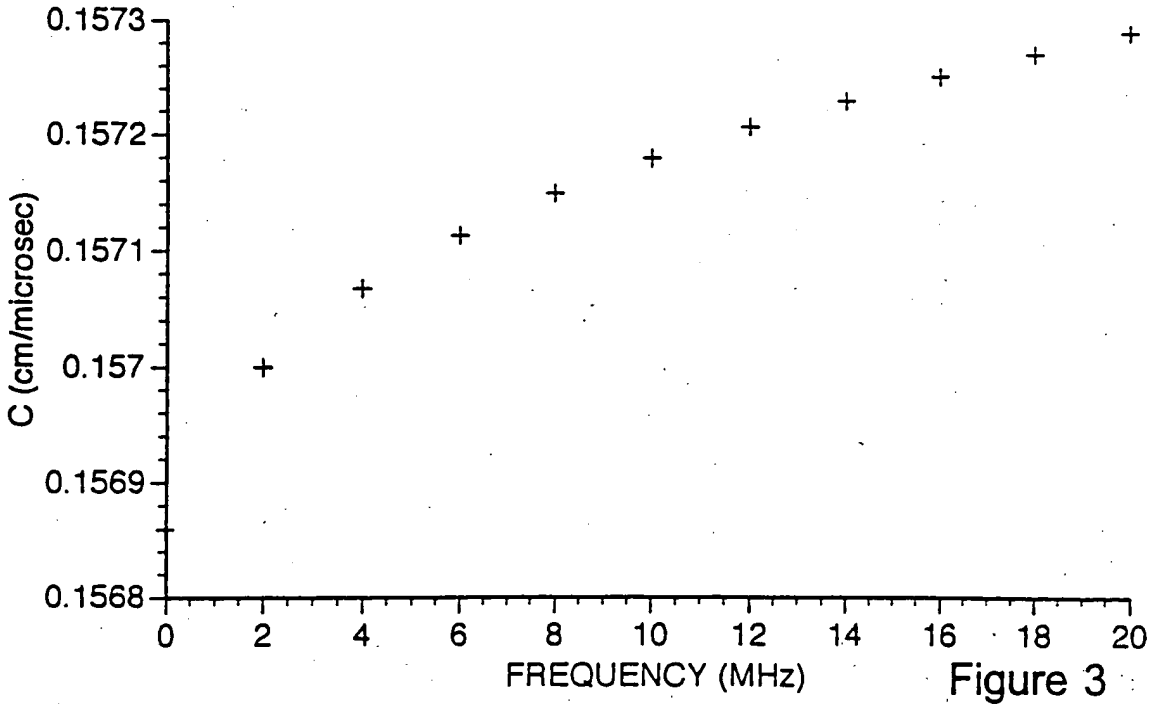


Figure 3

. The harmonic velocities used in propagating the 2 MHz Gaussian beam through liver.

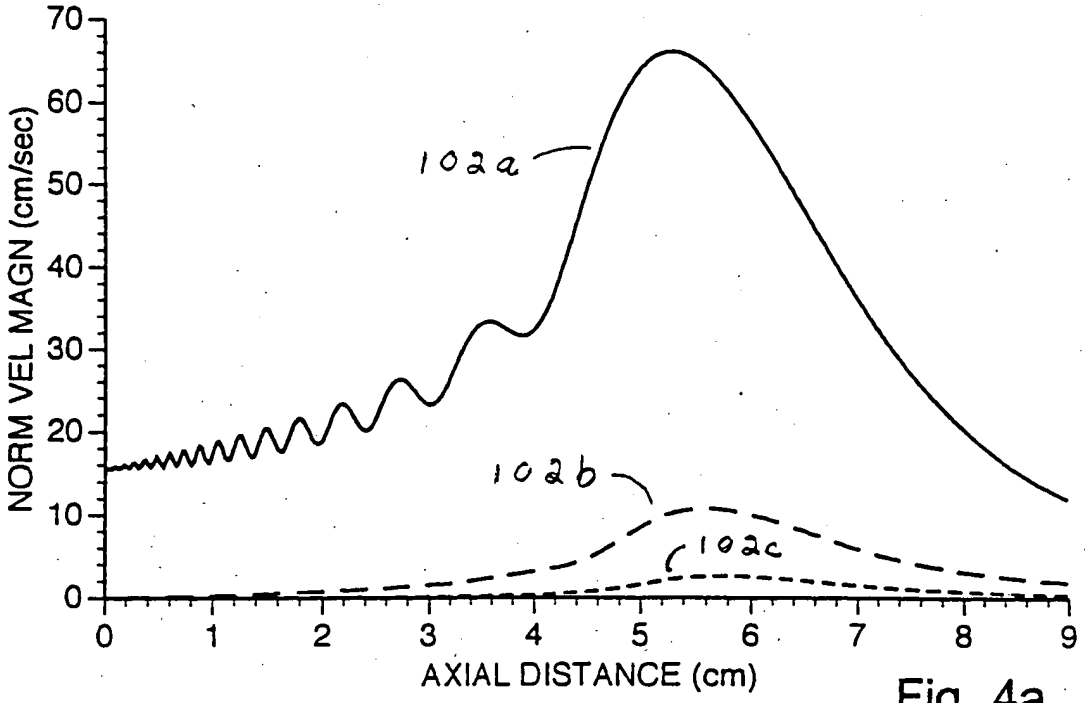


Fig. 4a

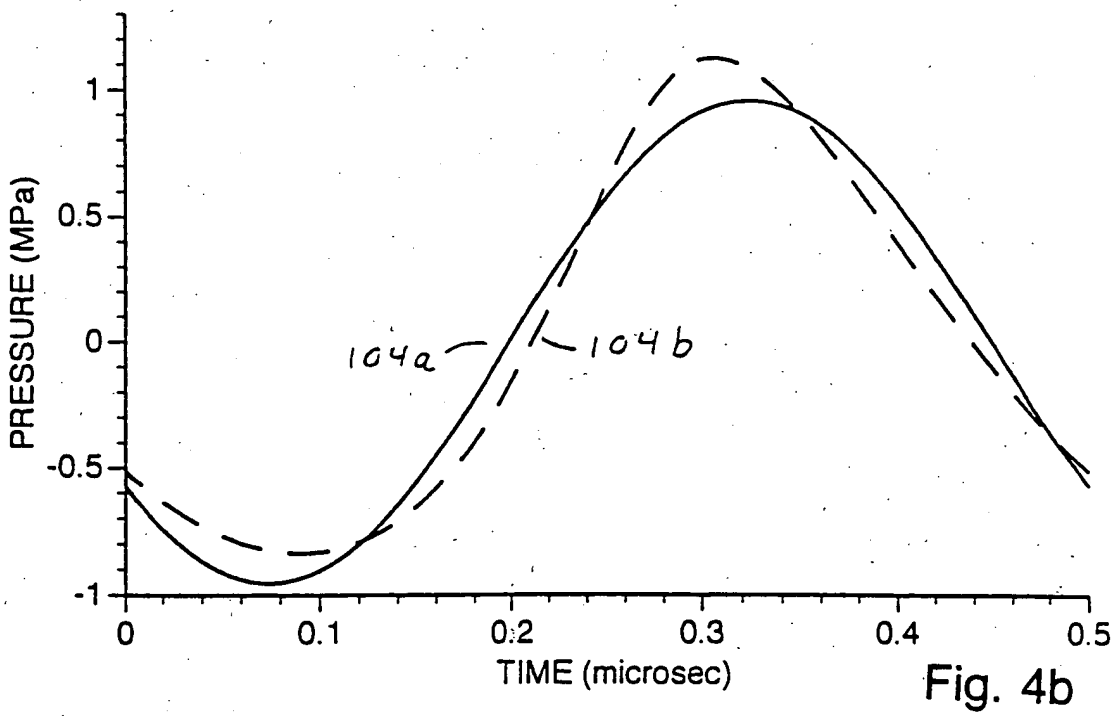


Fig. 4b

. Nonlinear propagation results for the focused 2 MHz Gaussian transducer. The propagation medium here and in all subsequent figures is liver. (a) The on-axis amplitudes of the fundamental, second, and third harmonics (top to bottom curves, respectively). (b) The focal (z = 6 cm) linear (solid curve) and nonlinear (dashed curve) waveforms.

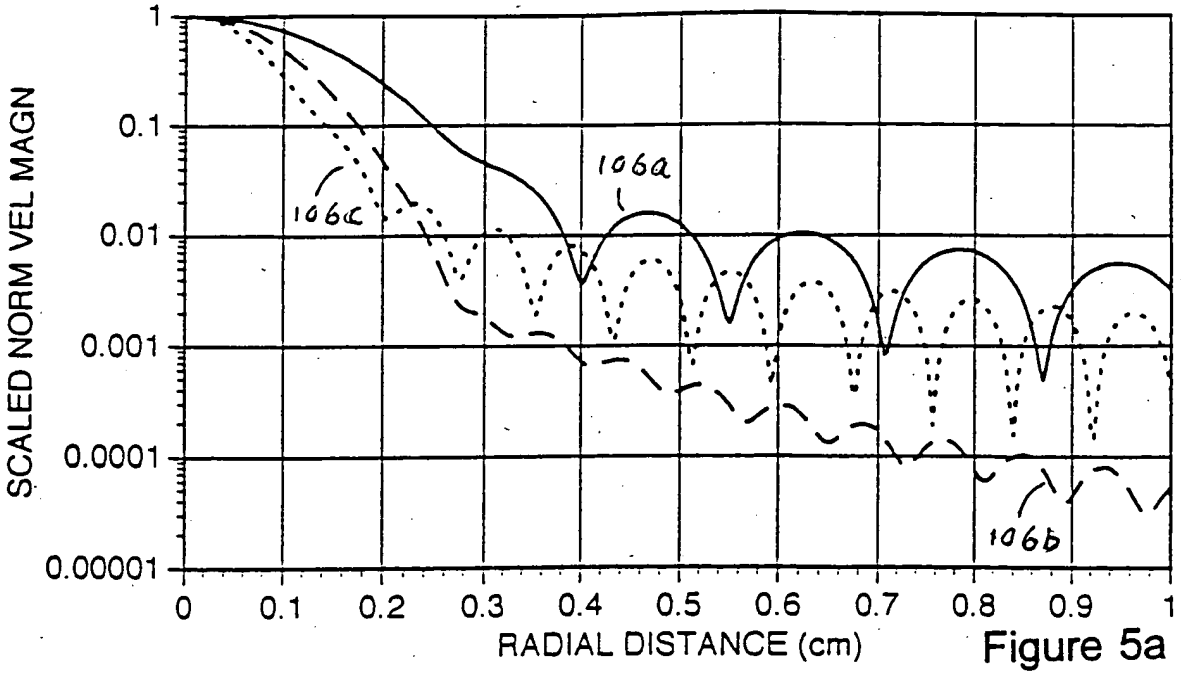


Figure 5a

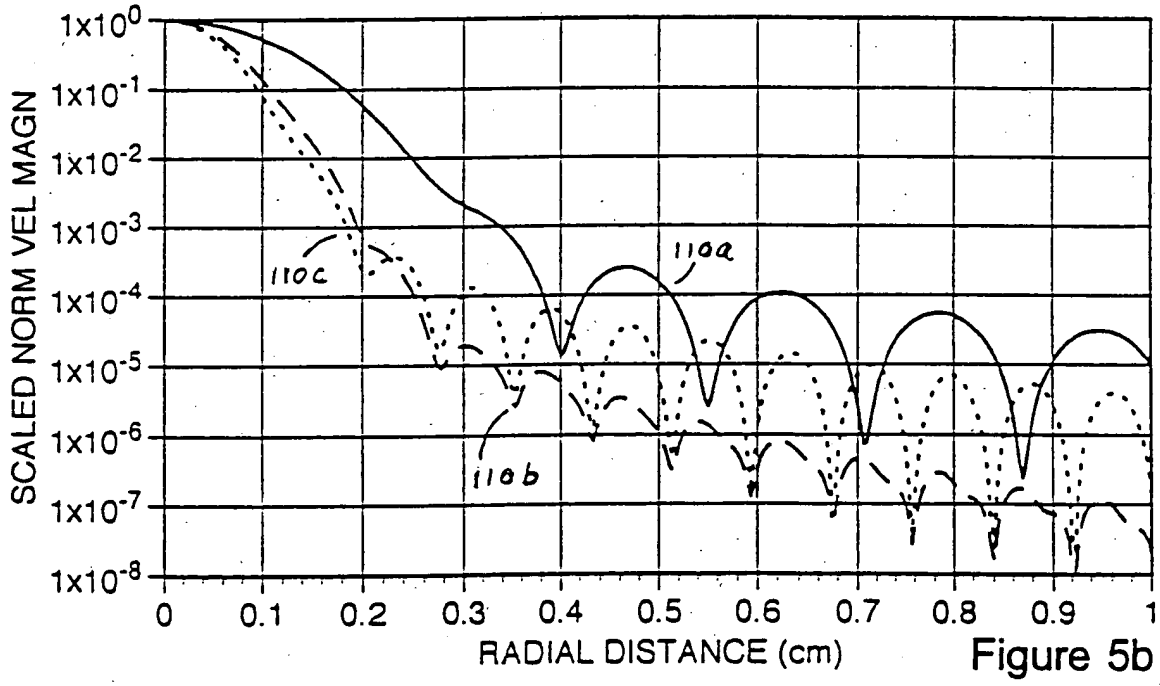


Figure 5b

Fundamental and second harmonic, one- and two-way focal plane beam patterns. (a) The log-scaled, normalized one-way focal plane profiles of the 2 MHz fundamental (solid curve), the 4 MHz second harmonic (long dash curve), and the 4 MHz fundamental (short dash curve). (b) The corresponding two-way profiles.

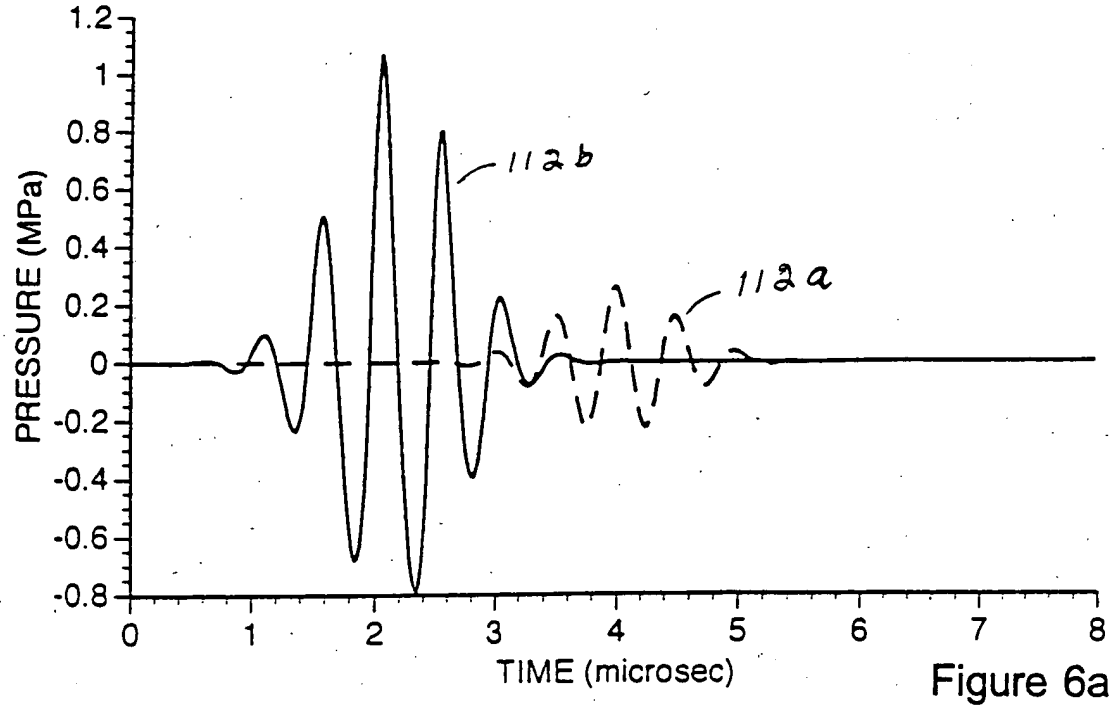


Figure 6a

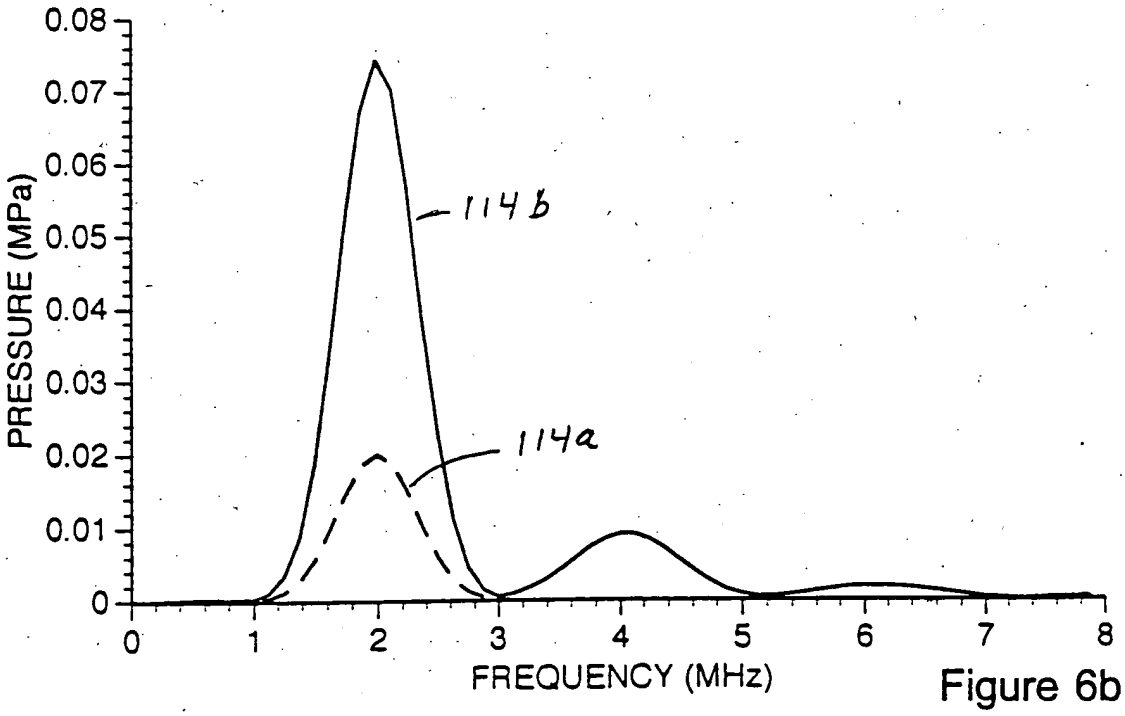


Figure 6b

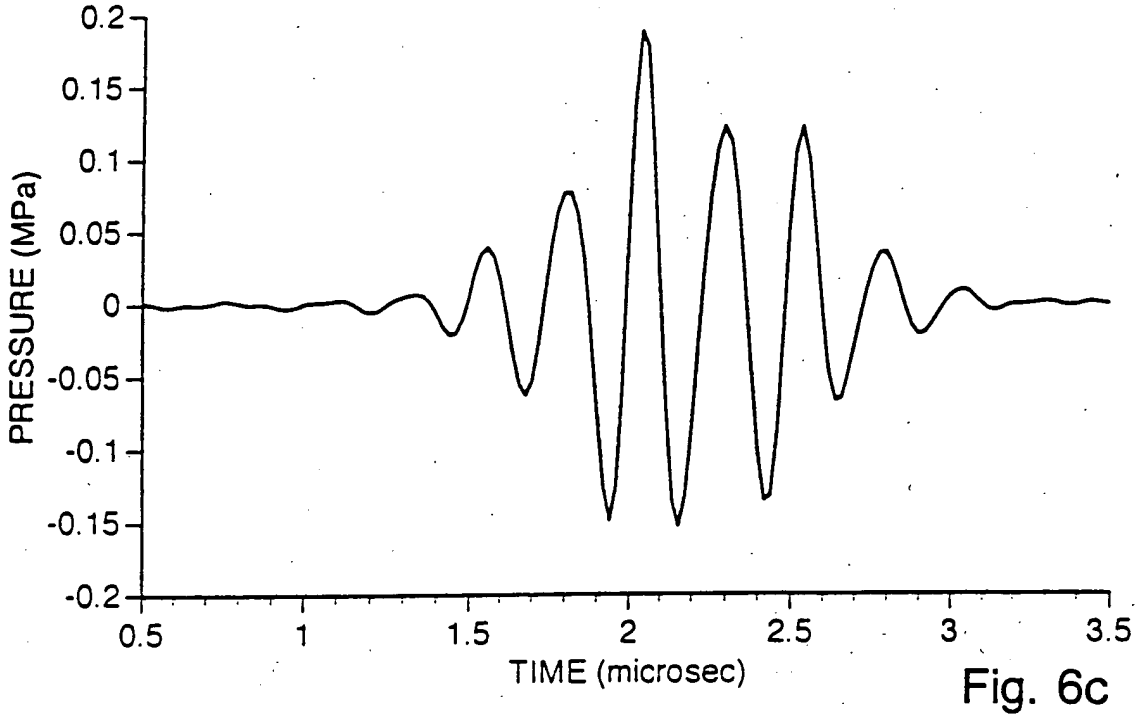


Fig. 6c

(a) The on-axis source plane (dashed curve) and subsequent focal plane (solid curve) 2 MHz-centered pulses. The period of the pulses is 8 microseconds. (b) The corresponding spectrums. (c) The focal nonlinear distortion pulse obtained by constructing the waveform using only the focal spectral information shown in (b) from 3 to 8 MHz.

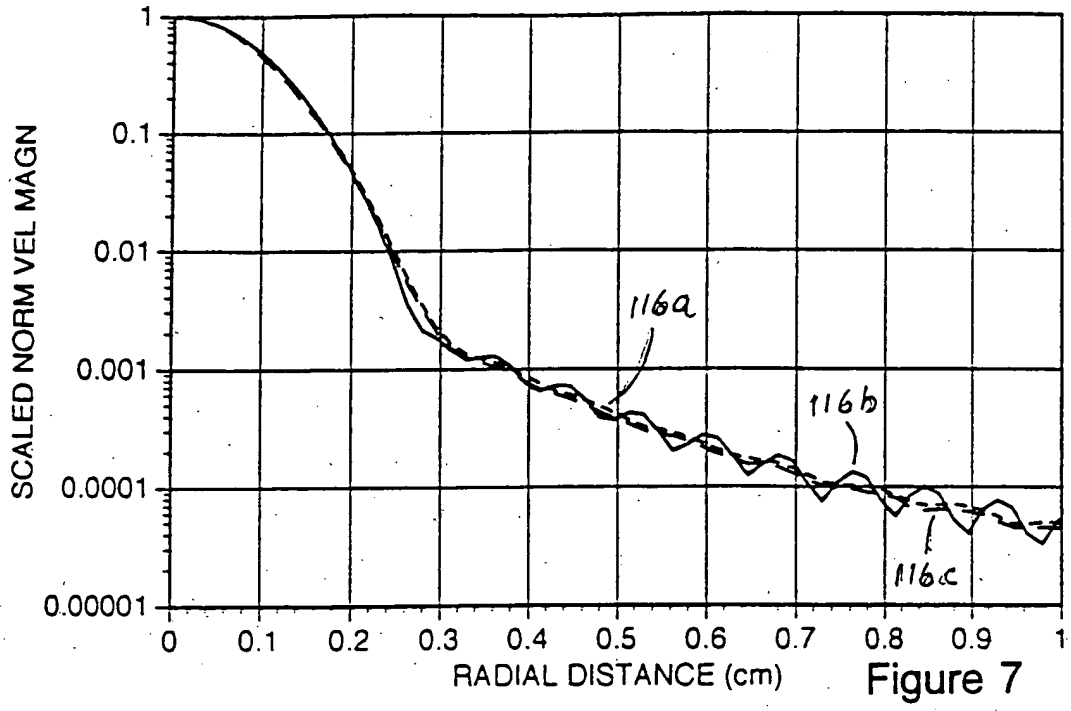


Figure 7

Focal plane profiles from the 2 MHz continuous wave propagation and the 2 MHz-centered pulse propagation. The solid curve depicts the 4 MHz second harmonic profile. The long dashed curve depicts the temporal peak amplitude profile computed using the frequency bandwidth of 3 to 8 MHz. The short dashed curve depicts the corresponding peak amplitude profile for the frequency range of 3 to 5 MHz.

On-axis source intensity (RMS w/cm^2)	Received 2nd harmonic level (dB)	Received 3rd harmonic level (dB)	Minimum pressure at the geometric focus (MPa)	Mechanical Index (min. press./sqrt(f))
0.5	26.54	50.88	-0.45	0.32
1	23.64	45.02	-0.61	0.43
2	20.73	39.23	-0.84	0.59
4	17.94	33.66	-1.13	0.80
8	15.37	28.59	-1.50	1.06

On-axis (spatial peak) source plane intensity versus received second and third harmonic levels (relative to 2 MHz fundamental) and focal field parameters.

Figure 8

Focal length (cm)	2nd harmonic level at the focus (dB)	Received 2nd harmonic level (dB)
4	15.99	19.75
6	15.11	20.73
8	15.01	22.53
10	15.29	24.69
12	15.83	27.07

Table 2. Focal and received second harmonic levels (relative to the fundamental) versus focal length. The geometric focus of the 2 MHz Gaussian transducer and the propagation length of the model were set to the five distances (6 cm was the previously considered case). The on-axis source intensity was 2 W cm^2 for all of the propagations.

Figure 9

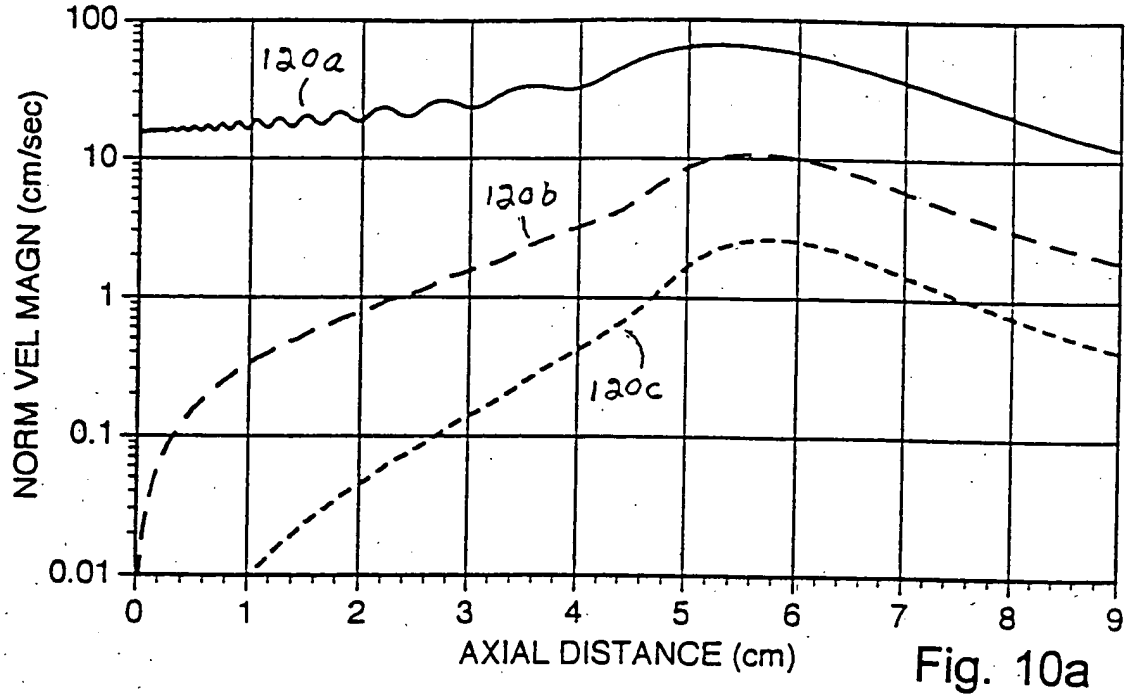


Fig. 10a

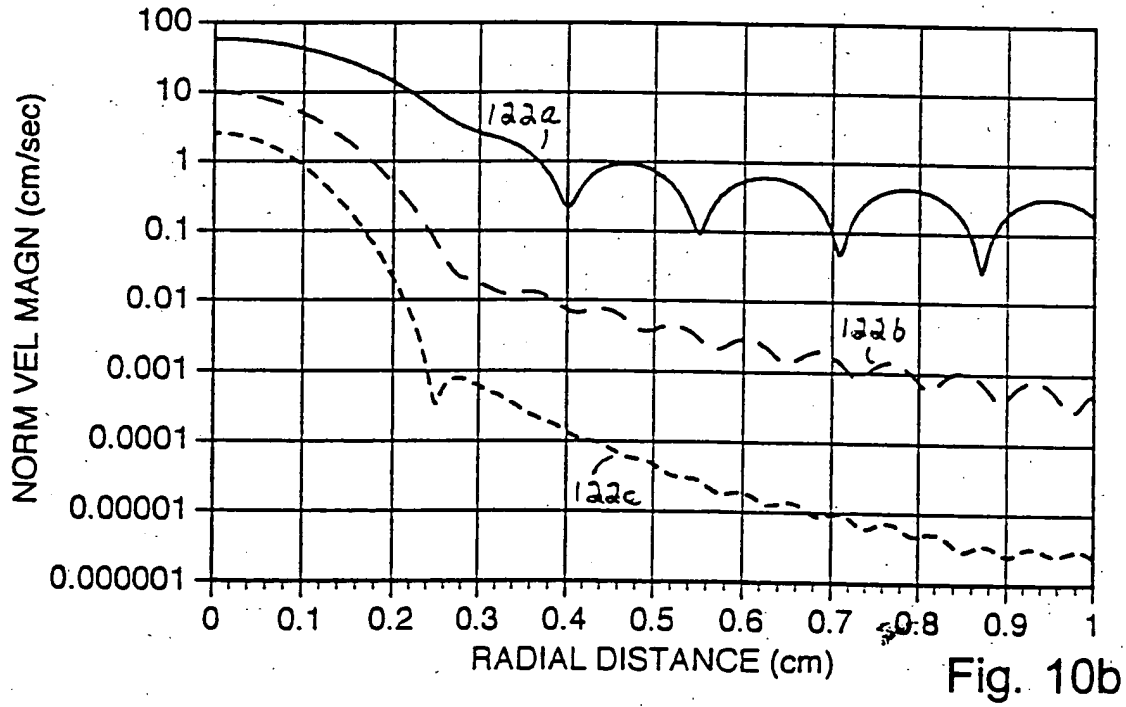


Fig. 10b

(a) Log-scaled first, second, and third harmonic axial amplitudes (top to bottom, respectively) for the focused 2 MHz Gaussian transducer. (b) The corresponding log-scaled, focal plane radial beam profiles.

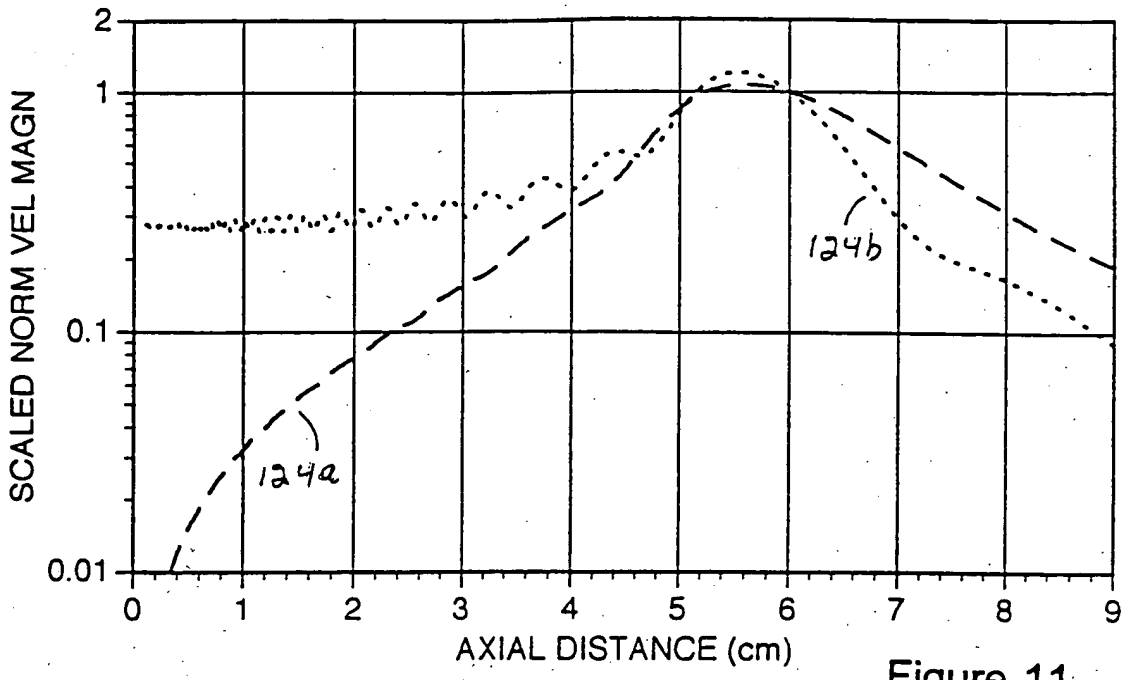

SCALED NORM VEL MAGN
2
1
0.1
0.01
0
1
2
3
4
5
6
7
8
9
AXIAL DISTANCE (cm)
124a
124b

Figure 11

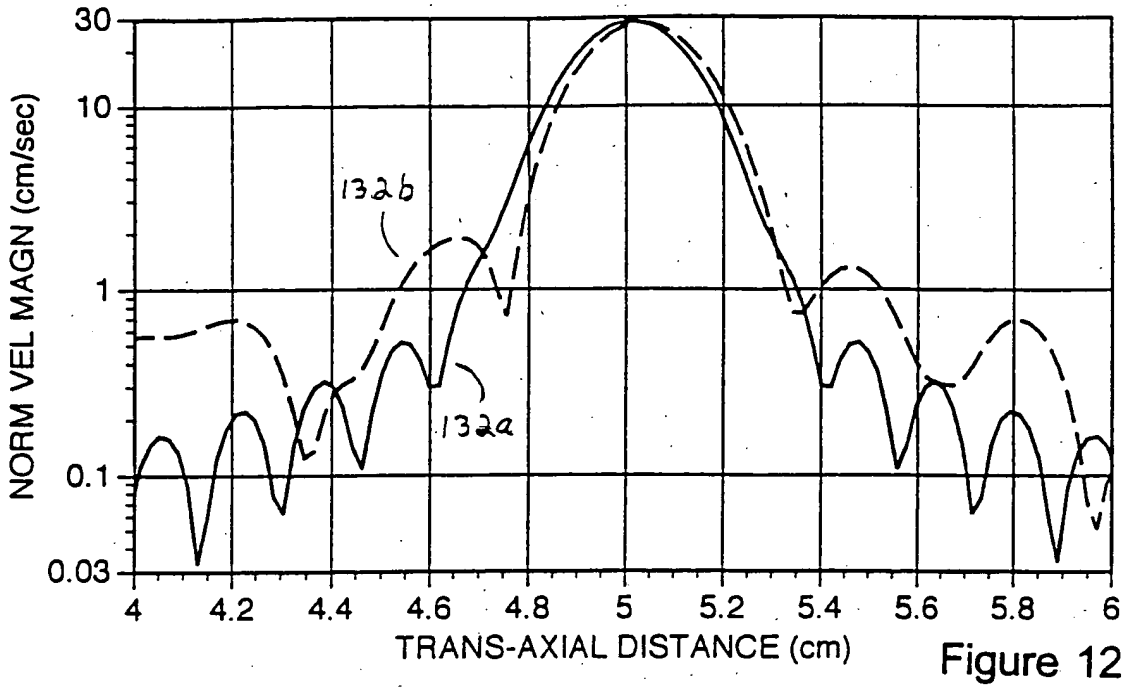


Figure 12a

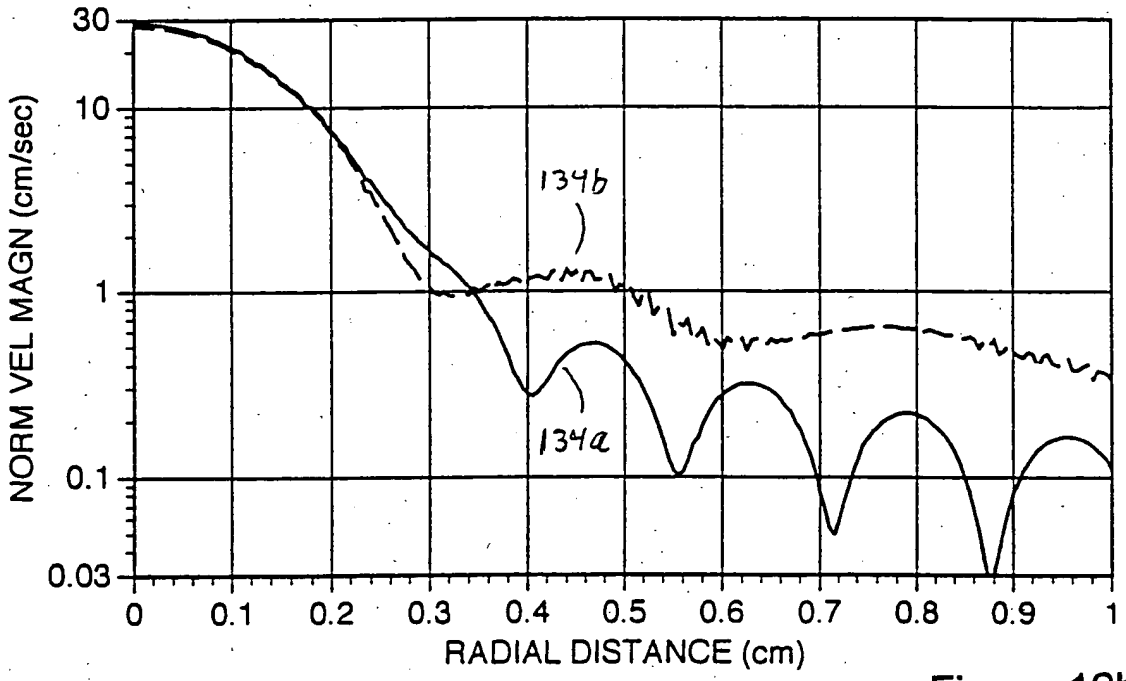


Figure 12b

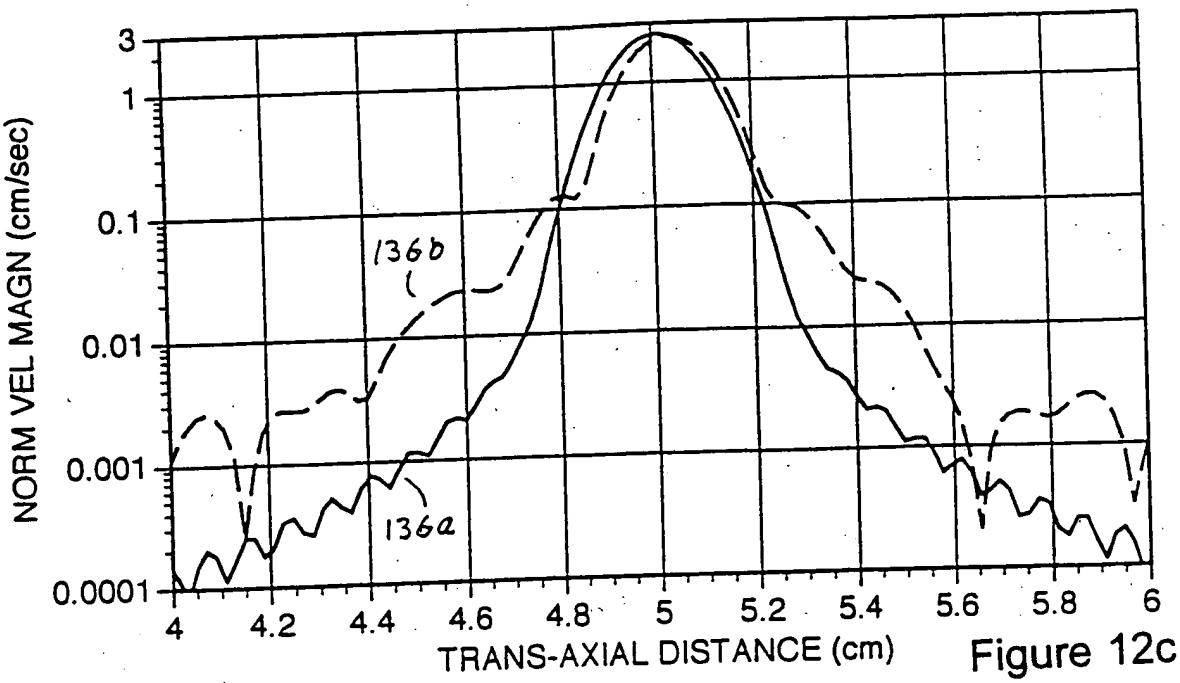


Figure 12c

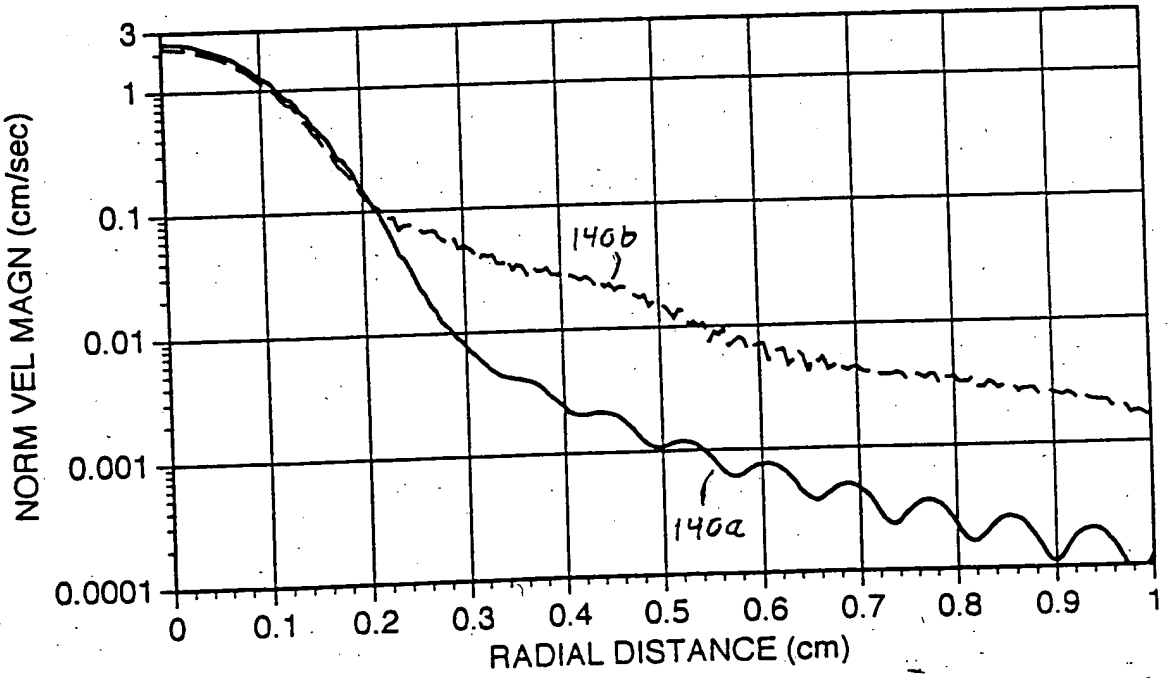


Fig. 12d

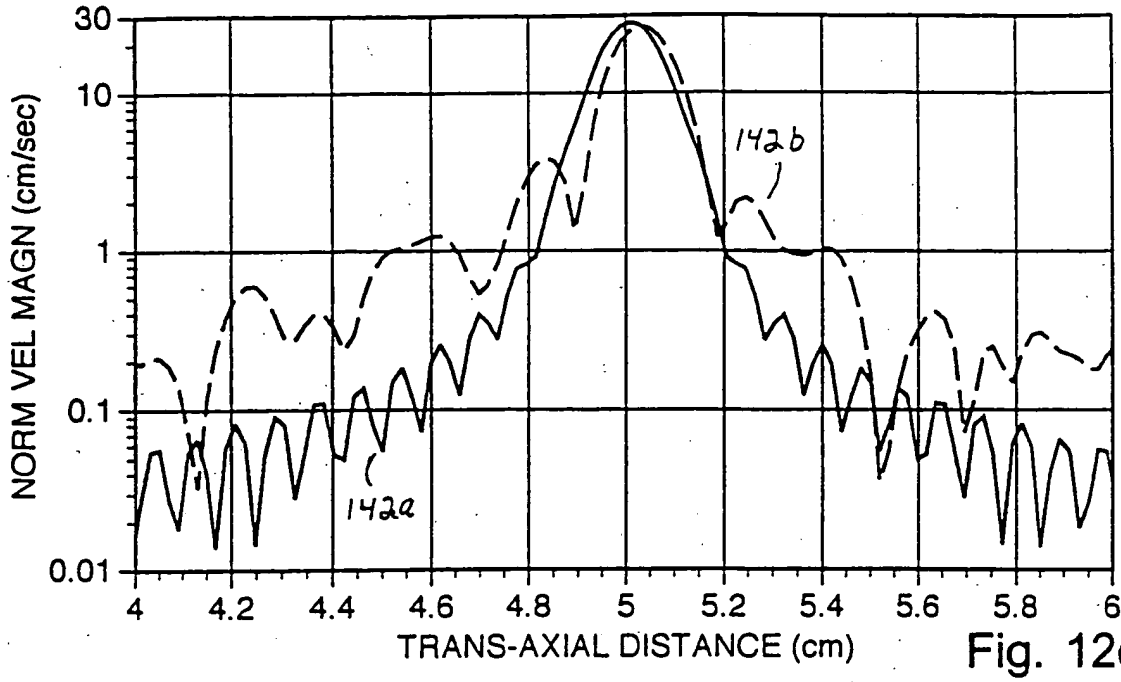


Fig. 12e

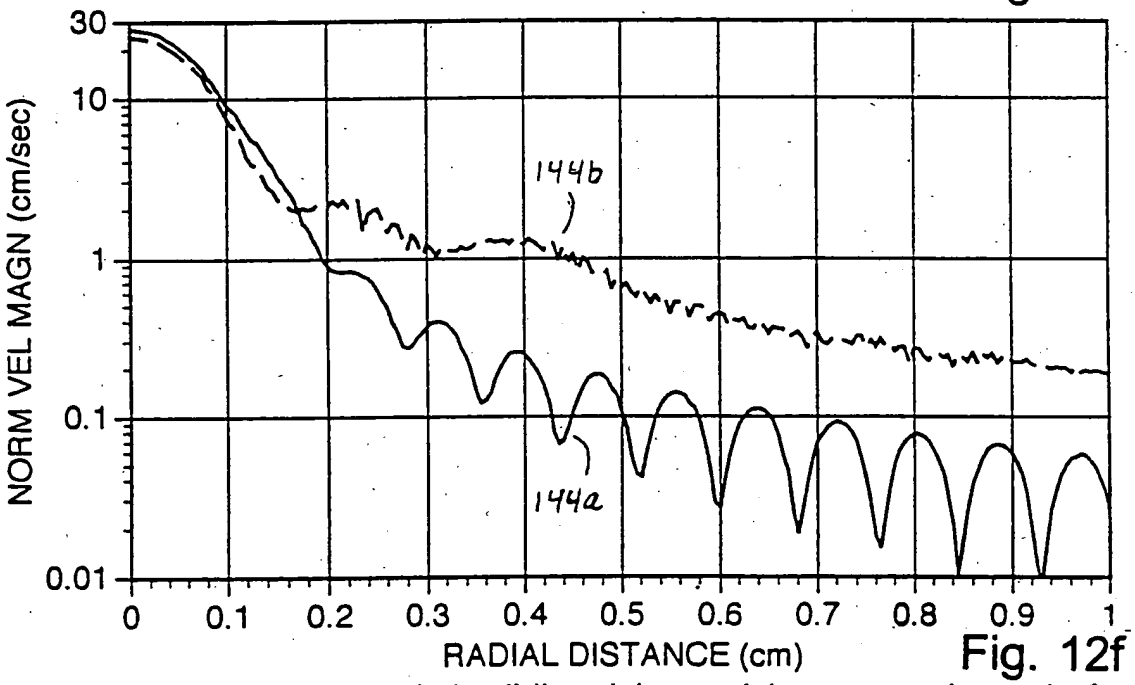


Fig. 12f

. Homogeneous and abdominal wall-jittered tissue path beam propagation results for the 2 and 4 MHz focused Gaussian transducers. Focal plane (one-way) profiles, the solid curves are the un-jittered or homogeneous tissue path results. (a) 2 MHz fundamental diameters. (b) Average radii from the 2 MHz focal plane profiles. (c) 4 MHz second harmonic diameters. (d) Average radii from the second harmonic 4 MHz profiles. (e) and (f) same format for the 4 MHz fundamental profiles.

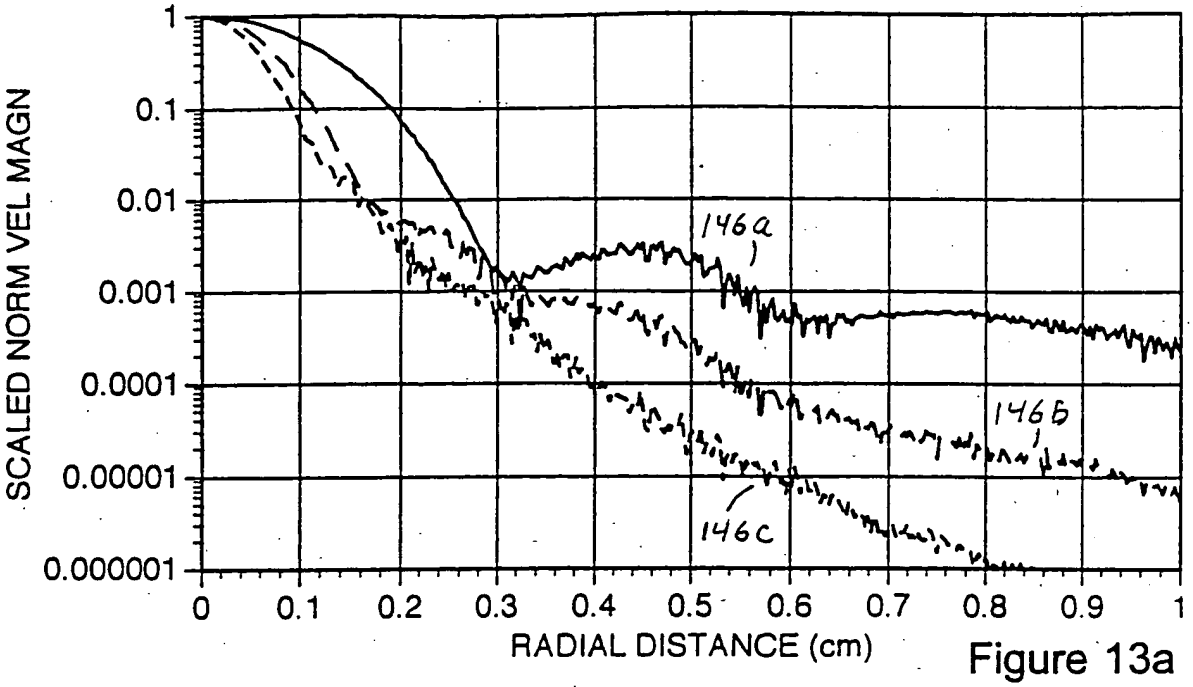


Figure 13a

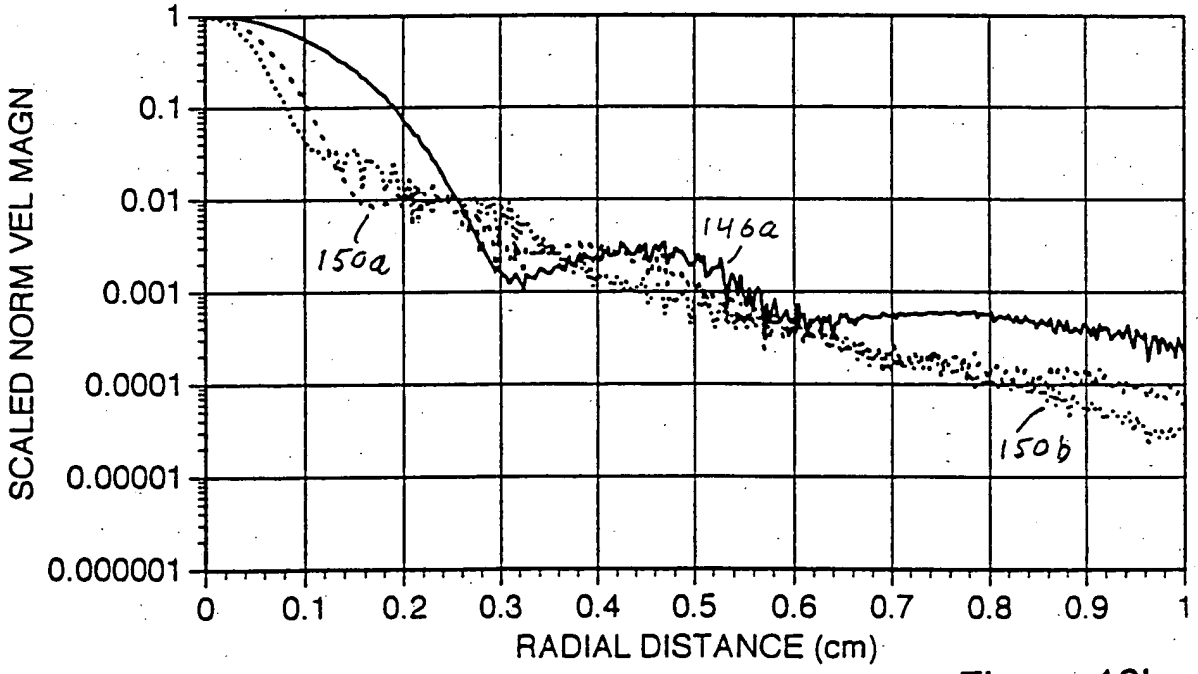


Figure 13b

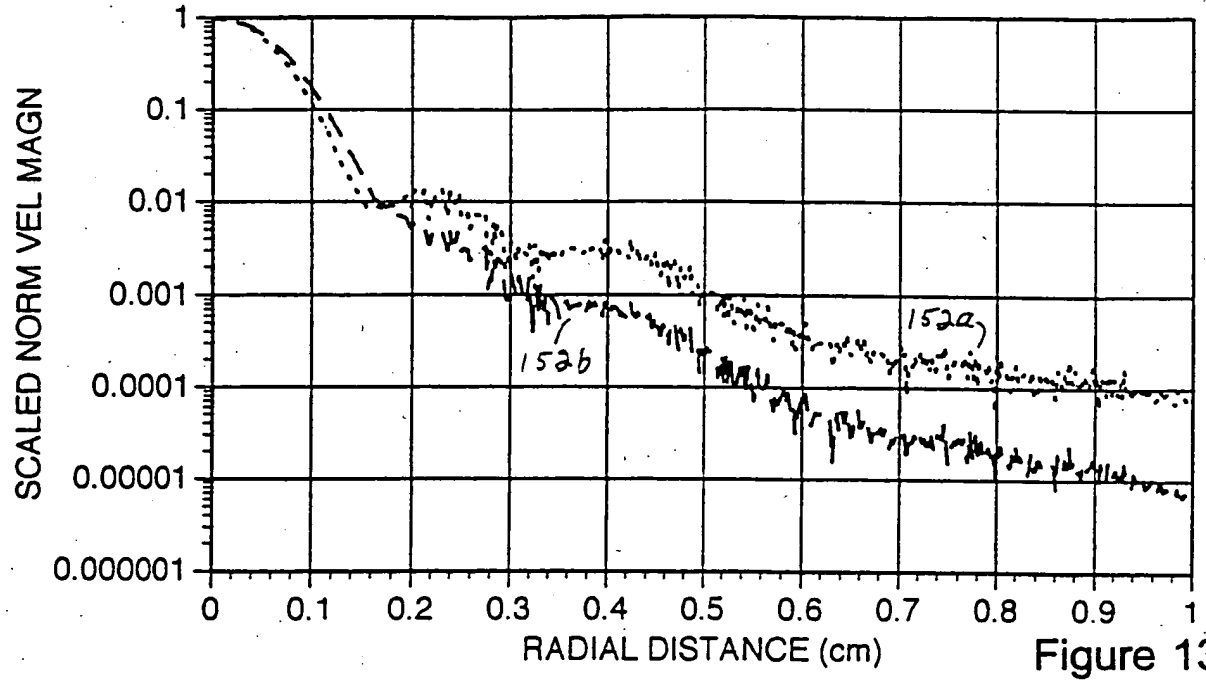


Figure 13c

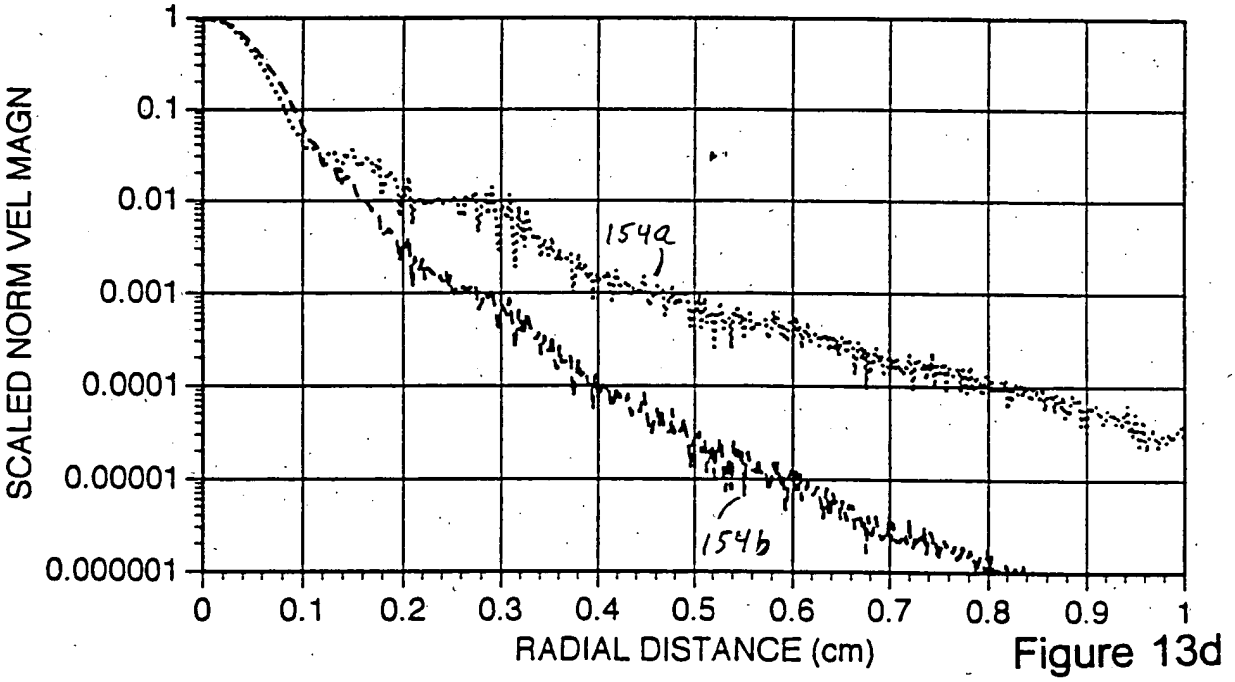


Figure 13d

. Additional results from the abdominal wall-jittered propagation patn case

(a) 2 MHz fundamental, 4 MHz second harmonic, and 6 MHz third harmonic average two way radii. (b) 2 MHz, 4 MHz, and 6 MHz fundamental or linear average two-way radii. (c) 4 MHz second harmonic and fundamental average two-way radii. (d) 6 MHz third harmonic and fundamental average two radii. The 4 and 6 MHz fundamental results in (c) and (d) are the shorter dash curves.

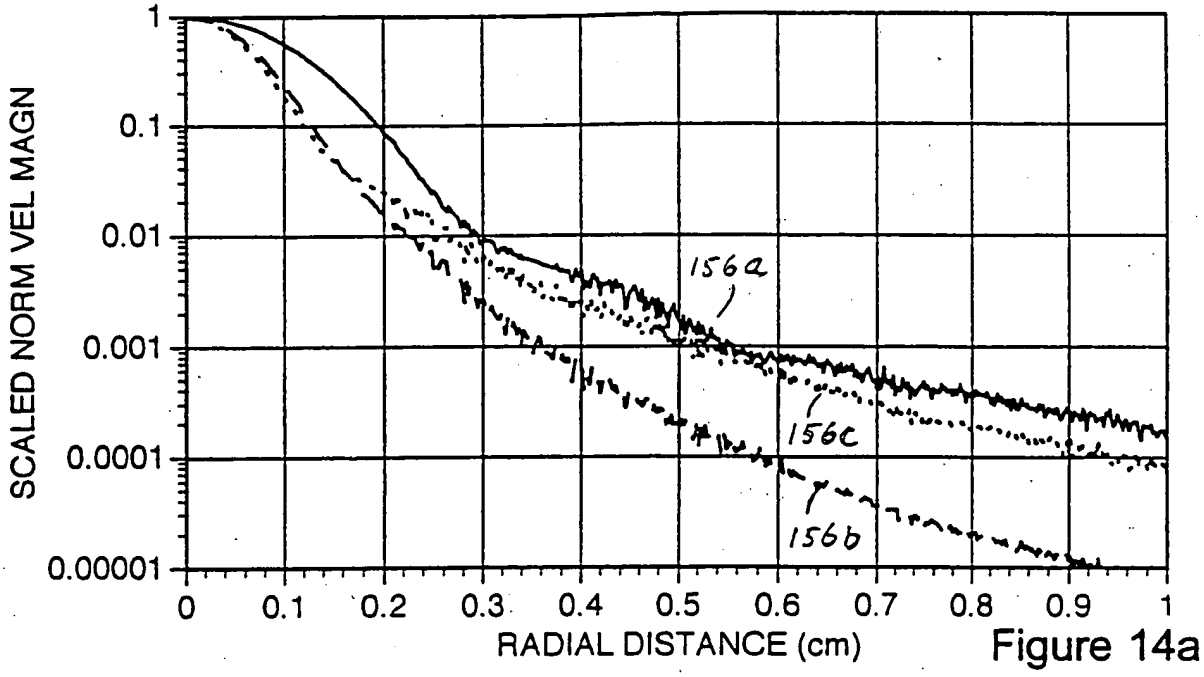


Figure 14a

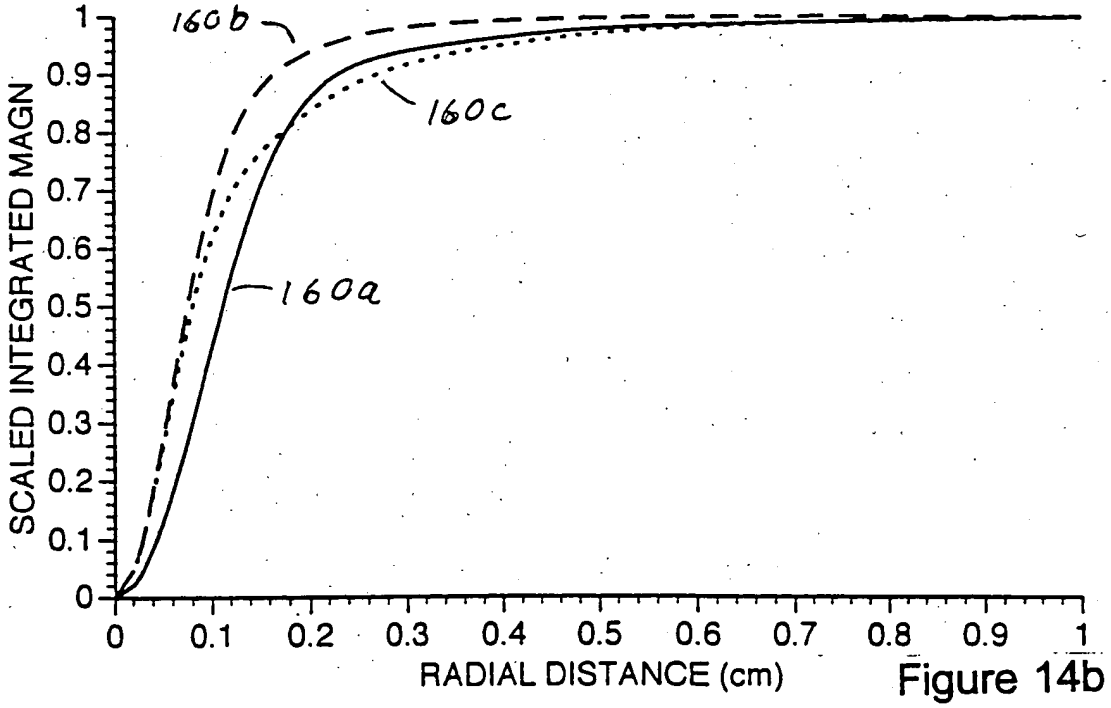


Figure 14b

. Two-way averaged radial results from five abdominal wall-jittered propagations. (a) Normalized two-way average radii for the 2 MHz fundamentals (solid curve), 4 MHz second harmonics (long dash curve), and 4 MHz fundamentals (short dash curve). (b) The corresponding radially integrated magnitudes. These curves have been normalized to have a unity value at r = 1.2 cm.

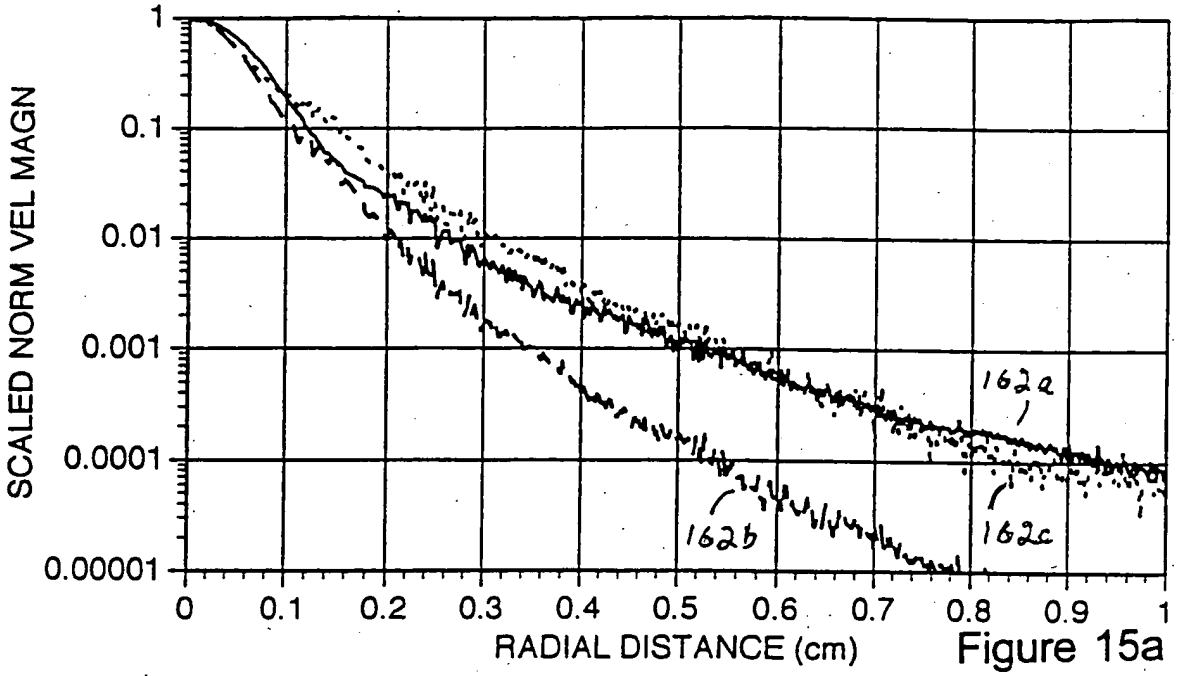


Figure 15a

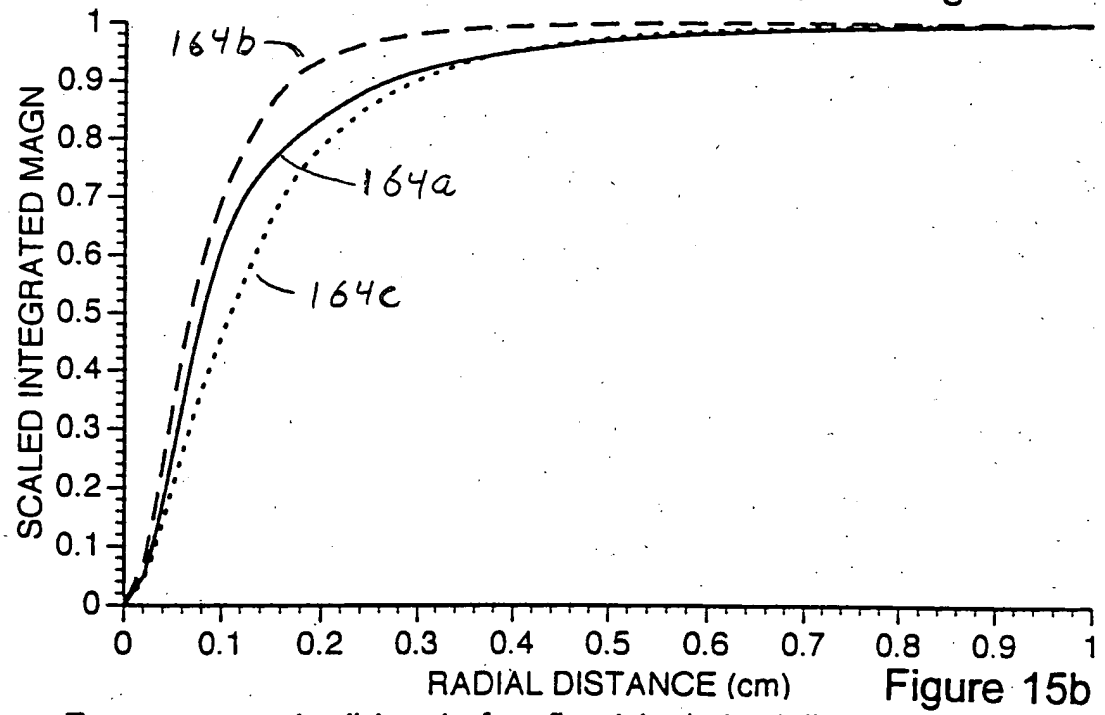


Figure 15b

Two-way averaged radial results from five abdominal wall-jittered propagations. (a) Normalized two-way average radii for the 4 MHz fundamentals (solid curve), 8 MHz second harmonics (long dash curve), and 8 MHz fundamentals (short dash curve). (b) The corresponding radially integrated, normalized magnitudes.

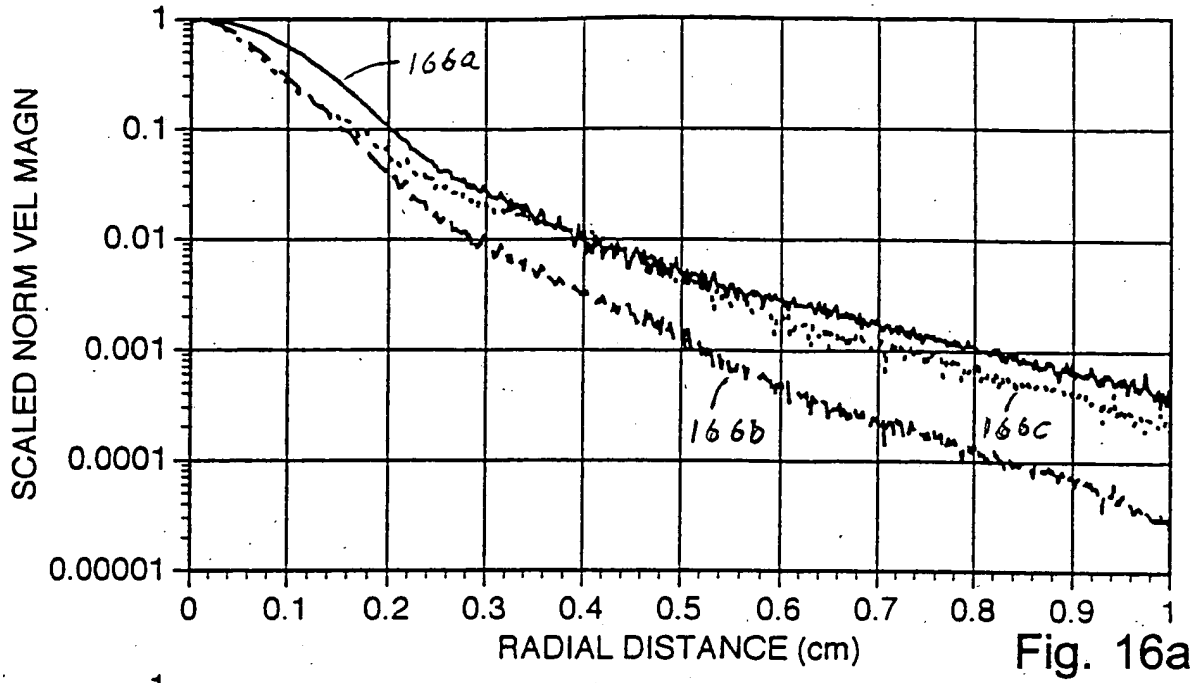


Fig. 16a

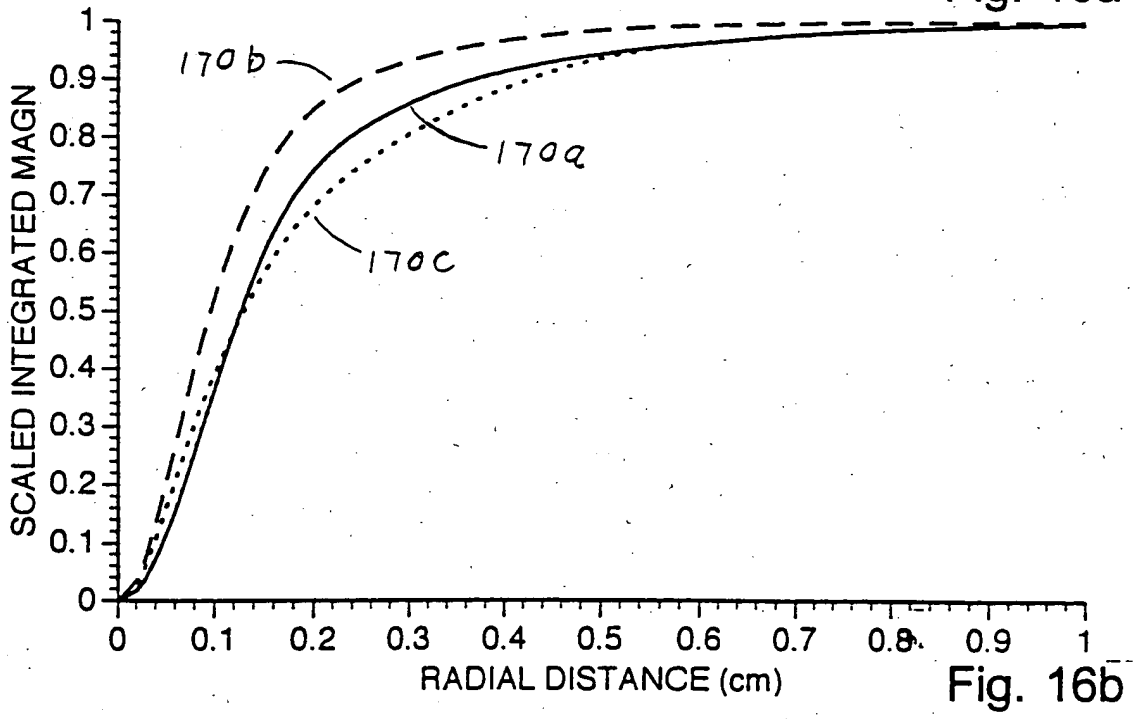


Fig. 16b

Two-way averaged radial results from five breast jittered propagations. (a) Normalized two-way average radii for the 2 MHz fundamentals (solid curve), 4 MHz second harmonics (long dash curve), and 4 MHz fundamentals (short dash curve). (b) The corresponding radially integrated magnitudes. These curves have been normalized to have a unity value at r = 1.2 cm.

Frequency / Medium	-20 dB full-width(cm)	0.9 Integrated full-width (cm)
2 MHz / ab wall	0.388	0.458
4 MHz / ab wall	0.242	0.542
2nd har 4 MHz / ab wall	0.258	0.332
8 MHz / ab wall	0.304	0.602
2nd har 8 MHz / ab wall	0.216	0.338
2 MHz / br wall	0.406	0.746
4 MHz / br wall	0.334	0.858
2nd har 4 MHz / br wall	0.308	0.504
8 MHz / br wall	0.462	0.880
2nd har 8 MHz / br wall	0.298	0.526

20 dB full-widths for the average two-way profiles shown in Figures 14a, 15a and 16a and the full-widths at the 0.9 level for the integrated profiles of Figures 14b, 15b and 16b. Also shown are the corresponding results from the 8 MHz breast jittered propagations.

Figure 17

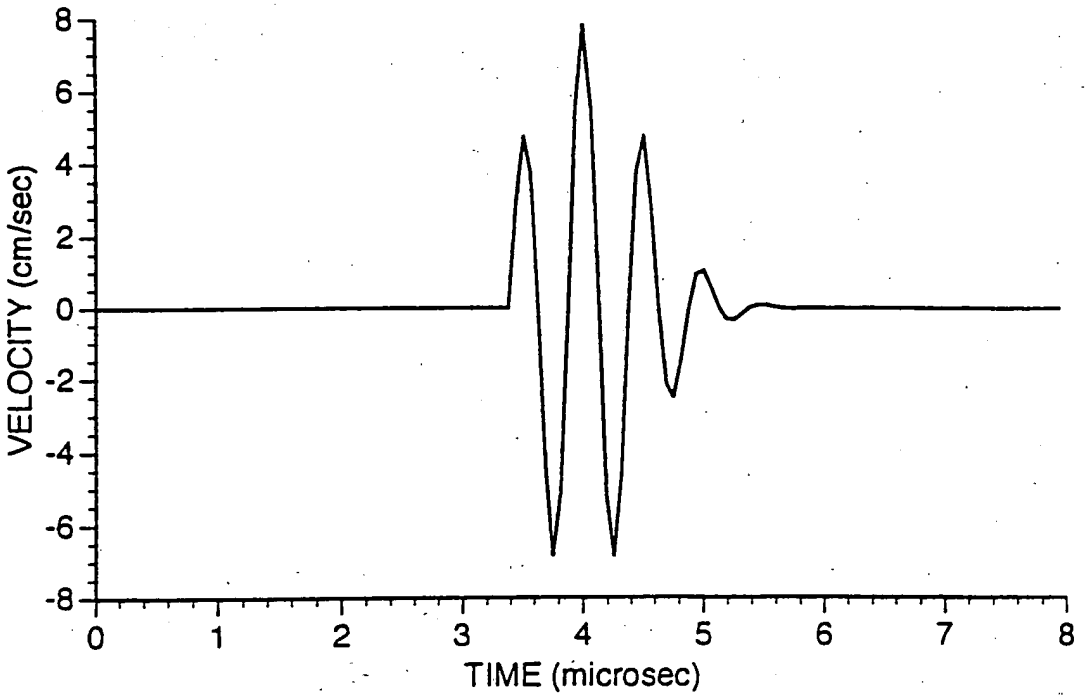


Figure 18a

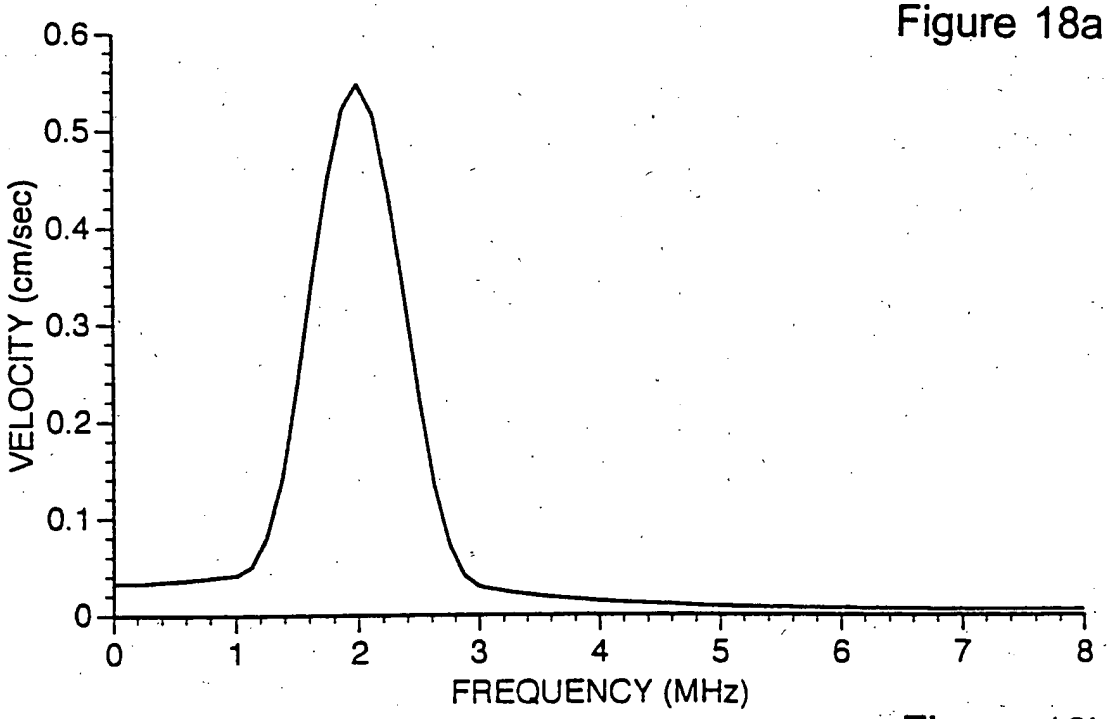


Figure 18b

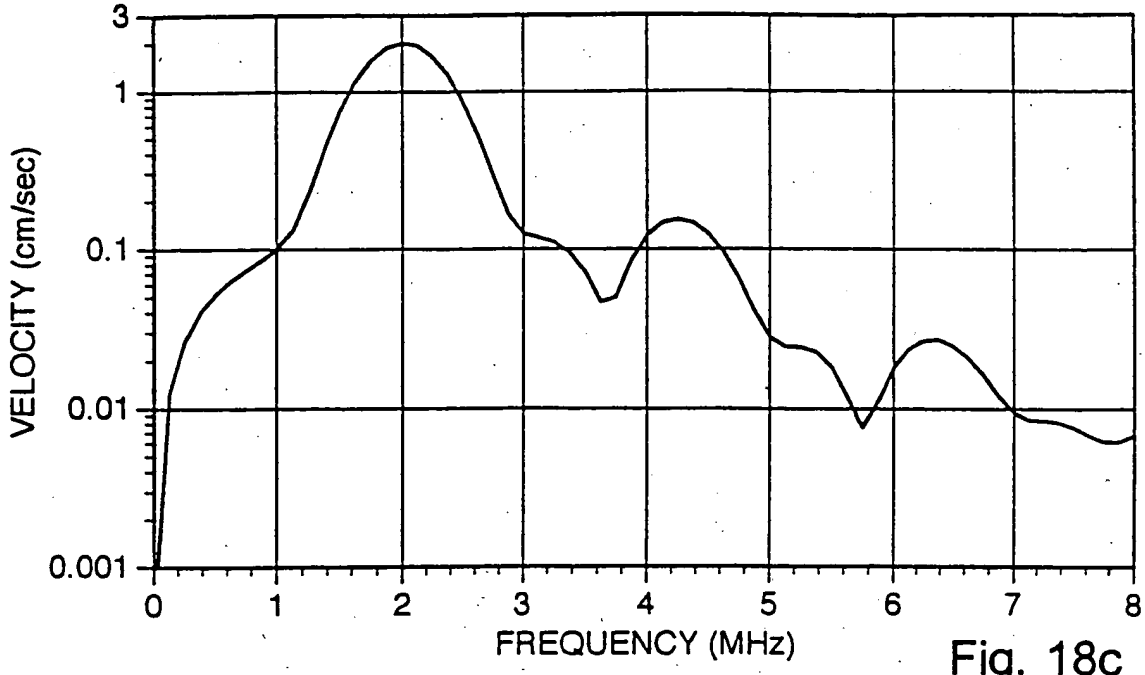


Fig. 18c

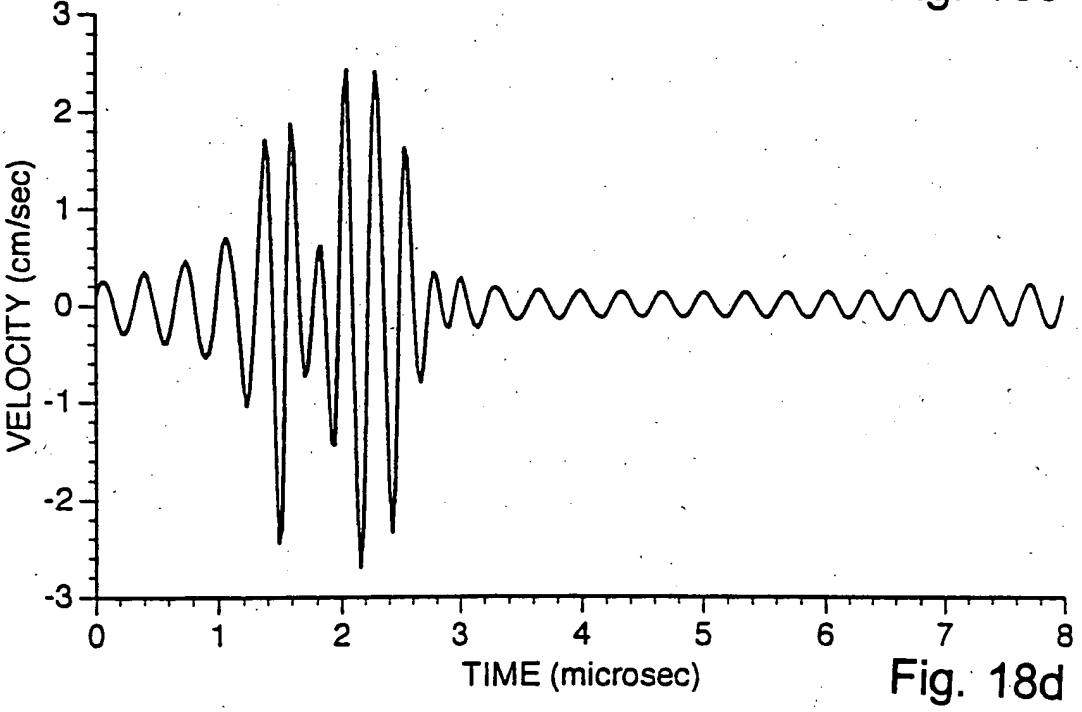


Fig. 18d

. (a) An imperfect (on-axis) source pulse. (b) The linearly-scaled spectrum. (c) The log-scaled focal spectrum. (d) The corresponding nonlinear distortion pulse obtained by constructing with the spectral information in (c) starting at 3 MHz.

Figure 19a

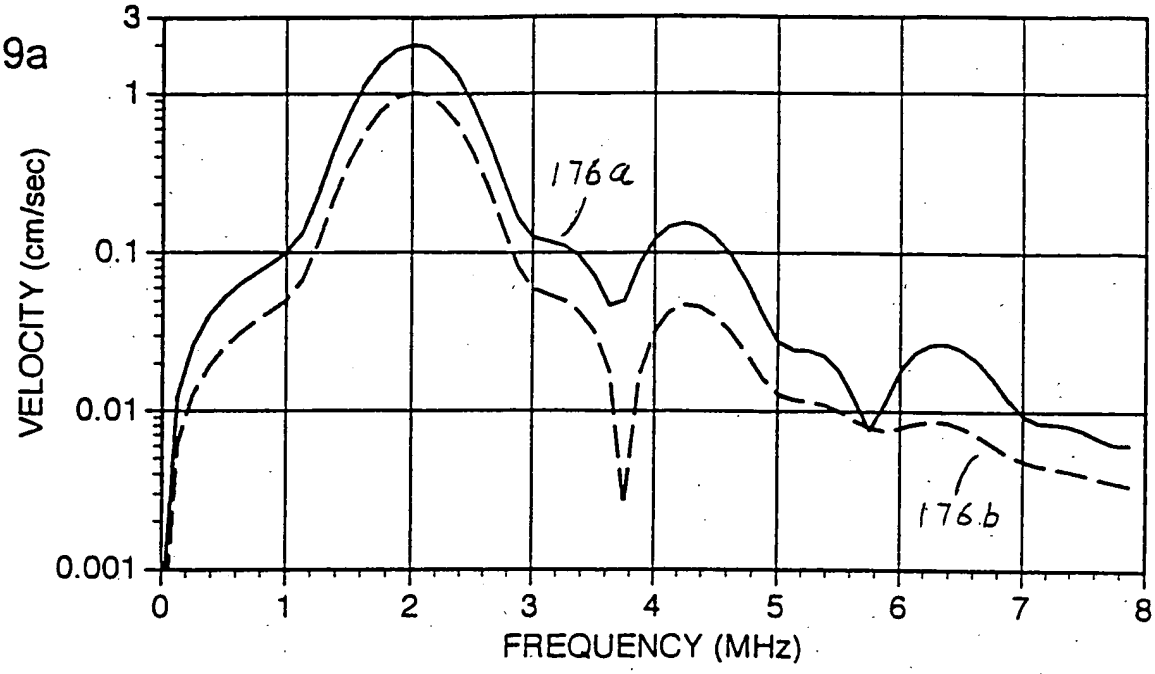
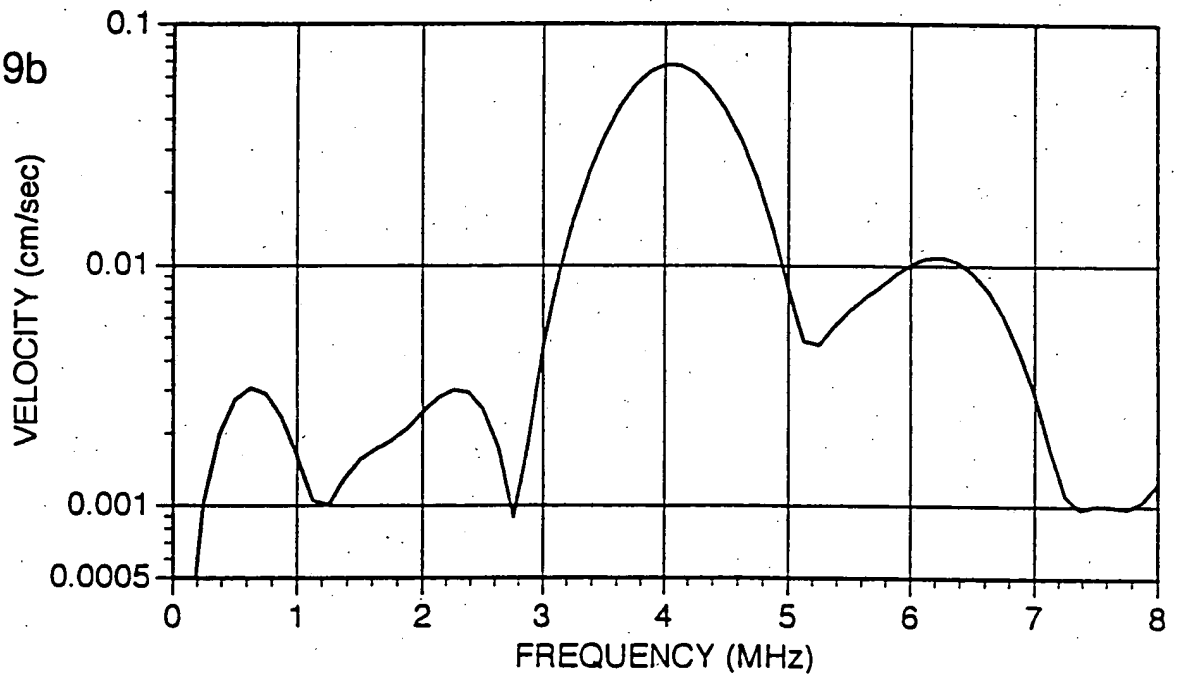


Figure 19b



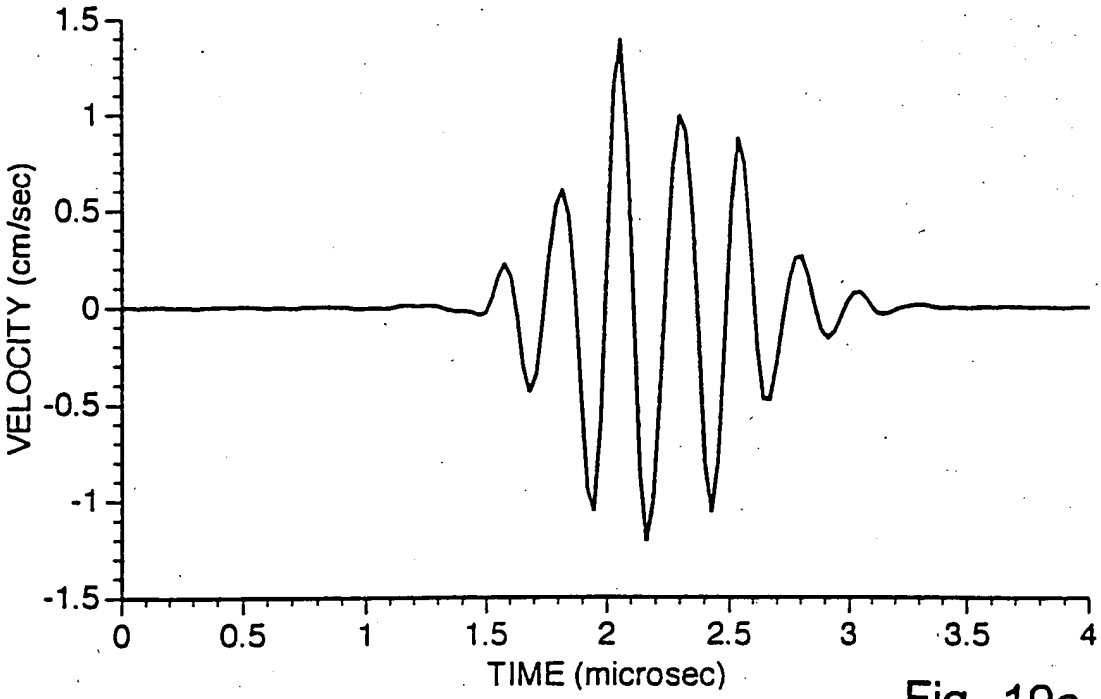


Fig. 19c

. The log-scaled focal spectrum from 18(c) overlaid with the focal spectrum from the same source using a half amplitude version of the source pulse (as depicted in Figure 18(a)). (b) The resulting difference spectrum computed for the two spectra shown in (a). (c) The corresponding nonlinear distortion pulse obtained by constructing with the spectral information in (b) starting at 2.75 MHz.